
CLINICAL ARTICLE

Dental treatment, antibiotic prophylaxis and infection in joint prostheses: A review of new trends and recommendations in the literature

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Abstract

Objectives: Current international and national prophylactic antibiotic regimens have been analysed in respect of the prevention of bacteraemia after dental and surgical procedures and therefore of joint prosthesis infection. This information was used to formulate guidelines for the Department of Maxillofacial and Oral Surgery.

Methods: Publications, since 2003, were used in this research. In addition recommendations of accredited institutions and associations were examined. These included the guidelines of the American Dental Association in association with the American Academy of Orthopaedic Surgeons (2003), the American Heart Association (2007), the Working Party of the British Society for Antimicrobial Chemotherapy (2006) and the Australian Dental Guidelines (2005). No guidelines published by any institution in South Africa were found.

Results: The general rationale for the use of antibiotic prophylaxis for surgical (including dental) interventions, is that those procedures may result in a bacteraemia that may cause infection in joint prostheses. Antibiotics, however, should therefore be administered to susceptible patients, e.g. immunocompromised patients, prior to the development of bacteraemia.

Conclusion: The guidelines recommended for use in South Africa are based solely on those used outside South Africa. South Africa is regarded as a developing country with its own population and demographic characteristics. Eleven percent of our population is infected with HIV, and a specific guideline for prophylactic antibiotic treatment is therefore essential.

There are many controversies in the dental literature, regarding the use of prophylactic antibiotics in patients with joint prostheses. Antibiotics are prescribed in dentistry to treat and prevent infections.¹

For the purpose of this article, the main indications and controversies relating to prophylactic use of antibiotics in dentistry will be reviewed, notably the prevention of bacteraemia and infections in patients with joint prostheses.

From small beginnings with hips in the early 1950s, joint replacement has expanded to include the knee, ankle, shoulder, elbow and finger joints. Generally these joint replacements are successful with an over 90% success rate over a 10-year period.² In the United States in 1995, 243 919 total knee replacements were performed² and in 2003, approximately 450 000 total joint arthroplasties were performed.^{3,4} In Australia in the financial year 2002-2003 a total of 55 836 total hip and knee replacements were performed.⁵ In Norway 73 000 arthroplasties were done between 1994 and 1999, i.e. in 11 years.⁶

Currently no register exists in South Africa on the total of any arthroplasties performed locally. The provision of joint prostheses is thus a common orthopaedic procedure.

Can orthopaedic implants be infected
by blood-borne bacteria?

Table 1: Prevalence of bacteraemia after dental procedures¹

PROCEDURE	PREVALENCE OF BACTERAEamia
Extractions (single)	51%
Extractions (multiple)	68-100%
Endodontics (intra-canal instrumentation)	0-31%
Endodontics (extra-canal instrumentation)	0-54%
Periodontal surgery (flap procedure)	36-88%
Periodontal surgery (gingivectomy)	83%
Scaling and root planning	8-80%
Periodontal prophylaxis	0-40%
Tooth brushing	0-26%
Dental flossing	20-58%
Interproximal cleaning with toothpicks	20-40%
Irrigation devices	7-50%
Chewing	17-51%

In the late 1950s and early 1960s, there was a high prevalence (15-25%) of postoperative infections associated with such surgery.¹ Infections that occurred within three months of surgery were categorised as early and were related to the surgical procedure either sourced from the patient or the surgical staff. Infections after three months of surgery were considered as late and we believed to be caused by haematogenous spread of bacteria from another site of infection elsewhere in the body.¹ The incidence of this is low and in the order of 0.97%.⁷ Antibiotic prophylaxis at the time of surgery reduced the prevalence of postoperative infection to approximately 1%.¹

Can orthopaedic implants be infected by blood-borne bacteria? Historically it was believed that one of the key sources of focal infection was the teeth.⁸ The basis of this theory was the process of anachoresis which is the preferential deposit of bacteria that have localised out of the bloodstream into areas of inflammation.⁹ Today we know oral bacteria clearly do enter the bloodstream during chewing, teeth clenching and tooth brushing although the amounts are small and transient. The greatest amount of bacteraemia occurs following extraction of erupted, periodontally involved teeth.⁸

Table 2: Incidence stratification of bacteraemic dental procedures^{3,23}

INCIDENCE	DENTAL PROCEDURE
Higher incidence [†]	Dental extractions
	Periodontal procedures, including surgery, subgingival placement of antibiotic fibres/strips, scaling and rootplanning, probing, recall maintenance
	Dental implant placement and replantation of avulsed teeth
	Endodontic instrumentation beyond the apex
	Endodontic surgery
	Placement of retraction cord
	Initial placement of orthodontic bands but not brackets
	Intraligamentary and intraosseous local anaesthetic injections
	Prophylactic cleaning of teeth or implants where bleeding is anticipated
	Lower incidence ^{‡♥}
Local anaesthetic injections	
Intracanal endodontic treatment, post placement and build-up	
Placement of rubberdam	
Postoperative suture removal	
Placement of removable prosthodontic/orthodontic appliances	
Taking of oral impressions	
Fluoride treatments	
Taking of oral radiographs	
Orthodontic appliance adjustment	

[†] Prophylaxis should be considered for patients with total joint replacement who meet the criteria in Table 3. No other patients with orthopaedic implants should be considered for antibiotic prophylaxis prior to dental treatment / procedures

[‡] Prophylaxis not indicated

[♥] Clinical judgement may indicate antibiotic use in selected circumstances that may create significant bleeding

* Includes restoration of carious (decayed) or missing teeth

The prevalent bacteria causing the late infection are *Staphylococcus aureus* (35%) and *Staphylococcus epidermidis* (15%). These are from skin origin. Group A *Streptococci*, which are mainly from oropharyngeal origin, occurred in about 8% of cases. Thus bacteraemic-related joint infections of oral origin may occur but generally at a low incidence. Skin organisms are the predominant group. The risk of oral-related infections is very low (0.04-0.07%).^{10,11} There is extensive soundly-based scientific literature on this.^{2,5,12-14} It is important that all papers which set out to document joint infections have meticulous methodology as it is easy for the source of the infection to be based on anecdote. Ideally, to confirm that an implant has been infected from an oral treatment, one requires a coincident history and an accurate and simultaneous typing of the oral flora bacteraemia and joint organisms.¹² These steps have not usually been taken in most investigations in the literature and some papers are based solely on history⁸ of dental treatment received before the arthroplasty procedure. There is scant evidence to suggest that dental-induced bacteraemia can cause haematogenous infection around a prosthetic joint.¹³ By contrast, there are several studies that show the opposite. They were unable to demonstrate any case of secondary joint infection after dental treatment in a patient who was not medically compromised. Even in a healthy patient with joint infection there was not enough evidence to link the infection to dental treatment.¹⁵⁻¹⁸

All surfaces of the body are colonised by a unique micro flora. Any bacteraemia may be caused by incision of the skin, gastroenteral mucosa, airway mucosa, genito-urinary mucosa or oral mucosa. Bacteria from these sources frequently enter the blood on a physiologic basis as a transient bacteraemia and are dealt with by the host defences.¹⁹

Oral bacteria clearly do enter the bloodstream during chewing, teeth clenching and tooth brushing although the amounts are small and transient.²⁰ Transient bacteraemias that follow normal activities such as chewing are usually cleared by the host defences within 10 minutes.²¹ Oral interventions including dental treatment will produce a greater bacteraemia than physiological function but is of a low grade and duration. Even a simple dental extraction in a patient with chronic periodontitis will result in a greater bacterial load than in a patient with optimal oral hygiene (*Table 1*).²²

Dental procedures can be classified into high and low risk, based on the levels of bacteraemia (*Table 2*).^{3,23}

Traditionally, 'significant bleeding' associated with a dental procedure has been equated with a bacteraemia. A recent study measuring pre- and post-procedure bacteraemia showed that bleeding was a poor predictor of odontogenic bacteraemia above usual physiological levels.²⁴

The rationale for the use of antibiotic prophylaxis for surgical, including dental, interventions is that the procedure causes bacteraemia and the bacteraemia may cause infection.

Therefore it is reasoned that the antibiotics should be given to susceptible patients before the bacteraemia is induced.¹⁹ Antibiotics may prevent infection either by killing bacteria or by damaging them to an extent that the host defences can then destroy them. General preventive measures (good dental care and skin hygiene, avoidance of unnecessary procedures and instrumentation) remain essential.¹⁹

Any dose of oral penicillin can cause an allergic reaction rate similar to that of intramuscular penicillin.²⁵ Hypersensitive patients receiving penicillin prophylaxis to prevent bacteraemia are five times more likely to die from an anaphylactic reaction to the drug than to die from contracting endocarditis.^{1,26} It would thus seem from these statistics that the risk of providing antibiotic coverage to prevent bacteraemias is far greater than not providing coverage.¹

Guidelines

Patients, especially immunocompromised patients, who are about to have a total joint arthroplasty should be in good dental health prior to surgery and should be encouraged to seek professional dental care if necessary. Patients who already have had a total joint arthroplasty should perform effective daily oral hygiene procedures to remove plaque and to establish and maintain good oral health.³ The risk of bacteraemia is far more substantial in a mouth with ongoing inflammation than in one that is healthy.²⁷

Bacteraemias can cause haematogenous seeding of total joint implants, both in the early postoperative period and for many years following impantation.²⁸ It appears that the most critical period is up to two years after implantation.²⁹ Presently, no scientific evidence supports the position that antibiotic prophylaxis to prevent haematogenous infections is required prior to dental treatment in patients with total joint prosthesis.²⁷

Antibiotic prophylaxis is not indicated for dental patients with pins, plates and screws, nor is it routinely indicated for most dental patients with total joint replacement. Antibiotic prophylaxis may be considered when the higher-risk dental procedures (*Table 2*) are performed on dental patients within two years post-implant surgery, on those who have had previous prosthetic joint infections and on those with some other conditions (*Table 3*).³ This position agrees with that taken by the ADA Council on Dental Therapeutics³⁰ and the American Academy of Oral Medicine³¹ and is similar to that taken by the British Society for Antimicrobial Chemotherapy.³²

There is limited evidence that some immunocompromised patients with total joint replacements (*Table 3*) may be at higher risk of experiencing haematogenous infections.³³⁻⁴⁰ Antibiotic prophylaxis for such patients undergoing dental procedures with higher bacteraemia risk should be considered using an empirical regimen (*Table 4*).

Table 3: Patients at potential increased risk of experiencing haematogenous total joint infection³

PATIENT TYPE	CONDITION PLACING PATIENT AT RISK
All patients during first two years following joint replacement	N/A [†]
Immunocompromised/ suppressed patients	Inflammatory arthropathies such as rheumatoid arthritis, systemic lupus erythematosus Drug- or radiation-induced immunosuppression Previous prosthetic joint infections Malnourishment
Patients with comorbidities [▲]	Haemophilia HIV infection Insulin-dependent (type 1) diabetes mellitus Malignancy

[†] N/A: Not applicable
[▲] Conditions shown for patients in this category are examples only; there may be additional conditions that place such patients at risk of experiencing haematogenous total joint infection

Table 4: Suggested antibiotic prophylaxis regimens^{3*}

PATIENT TYPE	SUGGESTED DRUG	REGIMEN
Patients not allergic to penicillin	Cephalexin, cephradine or amoxicillin	2 grams [†] orally 1 hour prior to dental procedure
Patients not allergic to penicillin and unable to take oral medication	Cefazolin or ampicillin	Cefazolin 1 g or ampicillin 2 g intramuscularly or intravenously 1 hour prior to the dental procedure
Patients allergic to penicillin	Clindamycin	600 mg orally 1 hour prior to the dental procedure
Patients allergic to penicillin and unable to take oral medications	Clindamycin	600 mg intravenously 1 hour prior to the dental procedure*

[†] There is evidence that 2 g is equivalent to 3 g oral amoxicillin with less risk of nausea⁴⁰
* No second doses are recommended for any of these dosing regimens

In addition, antibiotic prophylaxis may be considered when the higher-risk dental procedures (*Table 2*) are performed on dental patients within two years post-implant surgery,²⁸ on those who have had previous prosthetic joint infections and on those with some other conditions (*Table 3*).³

Summary

Common sense dictates that all patients undergoing joint replacement should be dentally fit. This should be confirmed by a dentist after full oral examination and radiographs. The common situation of the orthopaedic surgeon asking the patients if their teeth are 'OK' is not enough. A patient can be unaware of a painless condition like chronic periodontitis or chronic tooth-abscess which may arguably be a focus of infection.

Patients who already have had a total joint arthroplasty should perform effective daily oral hygiene procedures to

remove plaque (for example, by using manual or powered toothbrushes, inter-dental cleaners or oral irrigators) to establish and maintain good oral health. The risk of bacteraemia is far more substantial in a mouth with ongoing inflammation than in one that is healthy and employing these home oral hygiene devices. Dental treatment in the pre-implantation phase should be aggressive to eliminate current foci of infection. If the condition cannot be rapidly resolved by restorative, endodontic or periodontal treatment the involved teeth should be extracted.

Common sense dictates that all patients undergoing joint replacement should be dentally fit. This should be confirmed by a dentist after full oral examination and radiographs

Antibiotic prophylaxis would not usually be required for such pre-implantation treatment. In the initial phase following placement of a joint prosthesis, dental treatment would not normally be required if the patients have been made dentally fit prior to the procedure. The patients in this first three-month phase after receiving a prosthetic joint are usually in some orthopaedic discomfort and usually are not sufficiently mobile for routine dental treatment.

The guidelines recommended for use in South Africa are based solely on those used outside South Africa. South Africa is regarded as a developing country with its own population and demographic characteristics. Eleven percent of our population is infected with HIV⁴¹ which make them immunocompromised. The clinician is not always fully informed about the HIV-status of the patient. Therefore it must be considered to give antibiotic prophylaxis within the two years after joint replacement to all patients. Specific guidelines for prophylactic antibiotic treatment to prevent a bacteraemia are therefore essential for South Africa.

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